PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: MICHAEL KENNY *ET AL.*	EXAMINER: FRANKIE L. STINSON
APPLICATION NO.: 10/721,495	ART UNIT: 1746
FILED: NOVEMBER 25, 2003	CONF. NO: 6048
FOR: **SINGLE WAFER CLEANING WITH OZONE**	

DECLARATION OF ERIC J. BERGMAN UNDER 37 C.F.R. 1.132

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Commissioner for Patents
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Sir:

I, Eric J. Bergman, declare:

1. I am an inventor of the methods claimed in Application No. 10/721,495 entitled Single Wafer Cleaning with Ozone. I have over fifteen years of research and development experience in semiconductor processing. Much of my research and development work has been on ozone-based processing of semiconductor wafers. I am an author of multiple articles in this field. I am employed as a Process Engineer at Semitool, Inc., the Assignee of this Application. I am an inventor of over 40 U.S. patents and patent applications. Several of these patents and applications relate to processing with ozone and hot water, including the applications listed at 0001 of the present application No. 10/721,495.

2. I have reviewed Lampert *et al.*, U.S. Patent No. 5,181,985, in connection with the claims in the present application. I am familiar with Lampert *et al.* from examination of earlier patent applications on other ozone processes that I have invented. Lampert *et al.* describes a process using a gas in a mist of water. I do not find any suggestion in Lampert *et al.* of use of a liquid layer. The sections in Lampert *et al.* describing how the water is used are copied below:

Abstract:

A process for the wet-chemical surface treatment of semiconductor wafers in which aqueous phases containing one or more chemically active substances in solution act on the wafer surfaces, consisting of spraying a water mist over the wafer surfaces and then introducing chemically active substances in the gaseous state so that these gaseous substances combine with the water mist so that there is an interaction of the gas phase and the liquid phase taking place on the surface of the semiconductor wafer.

Col. 2, lines 1-9:

Accordingly, the present invention provides a process wherein chemically active substances are introduced in the gaseous state, and water is provided in a finely divided liquid state such as a mist, into a system containing the semiconductor wafers to be treated, and the phases acting on the semiconductor surfaces in the system are generated by the interaction of the chemically active gases and the liquid phase or water mist.

Col. 3, lines 40-50:

The water is introduced into the system containing the wafers to be cleaned in the form of a mist. The water can, for example, be sprayed in, fed in through nozzles or aerosolized. Nozzle systems used in conventional spray etching or spray cleaning processes are suitable for applying agents to the semiconductor wafers to be treated. Advantageously, droplet size, jet direction and jet force are matched to each other so that, at least in the region in which the semiconductor wafers are provided, a uniform aerosol-like water mist is built up.

Col. 3, lines 52-55:

Suitable gaseously supplied chemically active substances are those which can interact with the finely divided water to form phases which are active on the wafer surface.

Col. 3, lines 64-67:

It is then possible to control the supply of finely divided water and gaseous, chemically active substances and their uniform action on the wafer surfaces. The liquids produced in the process can also be collected and removed.

Col. 4, lines 12-17:

In principle, it is, also possible to operate mixed systems which have both the facility for introducing gases and also solutions. For example, a mixed system can be used where certain mixtures are employed which cannot be produced, or can

only be produced with difficulty, in a gaseous phase, such as, for example, hydrogen peroxide/ammonia or hydrogen peroxide/hydrogen chloride solutions.

Col. 4, lines 18-23:

Advantageously, the aqueous phases produced are removed as quickly as possible from the system after they have acted on the wafer surface in order not to upset the balance established between the solid, liquid and gas phases, and to aid in the removal of contaminants which have been collected in the process.

Col. 4, lines 34-47:

As a guide line, use may be made of the concentration values which are determined from conventional liquid-only processes for the corresponding solutions. From these concentrations, the quantitative ratios, and the required flow rates for components of the system can be derived, in each case, to a first approximation. For example, in the case where about 10% by weight hydrochloric acid solution is used, the quantities of hydrogen chloride gas and of finely divided water supplied to the system per unit time can be adjusted to a ratio by weight of about 1:9.

Col. 4, lines 58-66:

A converted spray etching chamber can, for example be used in which a continuous water mist is produced by means of a plurality of nozzles. Hydrogen fluoride gas is then injected into the system for a short time, and hydrofluoric acid is formed. This strips any oxide layer formed, together with the contaminants

contained therein from the wafer surface. After the HF gas is stopped, and while continuing to spray in water, the wafers are washed until acid-free. Then an ozonized oxygen stream is introduced for a short time to cause the formation of a superficial oxide layer. The wafers are then washed in the additive-free water mist.

Col. 5, lines 58-60:

Furthermore, it was possible to spray water into the chamber using a nozzle system that provided a homogeneous, aerosol-like spray mist in the interior space.

Col. 6, lines 6-11:

A process tray loaded with approx. 25 polished silicon wafers (diameter approx. 10 cm) was then placed on the rotating dish located in the system and rotated along the longitudinal axis of the spray chamber. At the same time, water was sprayed in and the wafers were quickly surrounded by a dense water mist.

Based on my education and experience in wafer processing using water and ozone, I do not see that any of these sections, or any other sections of Lampert *et al.*, could reasonably suggest use of a layer of liquid on the wafer and a step of controlling the thickness of the liquid layer. Lampert *et al.* repeatedly describes only use of a mist of water. The mist, or "finely divided water" is reacted with a gas. Use of a mist is apparently important because the mist provides a large surface area of water, for reaction with the process gas. The reference in Lampert *et al.* to droplet size further emphasizes the need for surface chemical reactions between the water and the process gas used in Lampert *et al.*

In the process described in the claims, having a liquid layer with a controlled thickness can be important, since ozone diffuses through the liquid layer. If there is no liquid layer on the wafer, or if the liquid layer is too thick, ozone movement to the wafer surface by diffusion is impaired (or non-existent). Lampert *et al.* does not mention diffusion of ozone, or any other gas.

I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 under Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: Aug. 2, 2006

Eric J. Bergman

Eric J. Bergman

Certificate of Electronic Filing

I hereby certify that this Declaration of Eric J. Bergman Under 37 C.F.R. 1.132 is being electronically filed with the U.S. Patent and Trademark Office on the date entered below.

August 7, 2006	Debbie Gilbert
Date of Electronic Submission	Debbie Gilbert